AD-A103 111 CENTER FOR NAVAL ANALYSES ALEXANDRIA VA INST OF NAVAL--ETC F/G 15/5
A COMPARISON OF CASREPS AND ENGINEERING LOGS IN MEASURING SHIP --ETC(U)
APR 81 J A BERNING N00014-76-C-0001
UNCLASSIFIED CRC-447 NL

1 OF 1
AD A

END
DATE FILMED
9-81
DTIC

LEVEL

CRC 447 / April 1981

ADA103111

A COMPARISON OF CASREPs AND ENGINEERING LOGS IN MEASURING SHIP MATERIAL CONDITION

John A. Berning, Jr.

CNA

CENTER FOR NAVAL ANALYSES

Work conducted under contract N00014-76-C-0001

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CRC-447	2. GOVT ACCESSION NO. AD-A103 111	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A Comparison of CASREPs and Engineering Logs in Measuring Ship Material Condition		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John A. Berning, Jr		8. CONTRACT OR GRANT NUMBER(s) N00014-76-C-0001
9. PERFORMING ORGANIZATION NAME AND ADDRESS Center for Naval Analyses 2000 No. Beauregard Street Alexandria, Virginia 22311		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research Department of the Navy Arlington, Virginia 22217		12. REPORT DATE April 1981
		13. NUMBER OF PAGES 27
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Office of the Chief of Naval Operations (Op96) Department of the Navy Washington, D.C. 20350		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This Research Contribution does not necessarily represent the opinion of the Department of the Navy.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

CASREPs, engineering logs, Equipment Identification Codes (EIC), frigates, ship maintenance, ship readiness, ships material condition

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Measurement of ship material condition may be based on equipment downtime, using either Casualty Reports (CASREPs) or ship engineering logs. Measurements based on these sources are compared, and the correlation between them is studied. Data for this statistical analysis represents 13 hull, mechanical, or electrical ship systems from FF-1052 class ships.

125

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE S/N 0102-014-6601

403 542

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

CENTER FOR NAVAL ANALYSES
2000 North Beauregard Street, Alexandria, Virginia 22311 Telephone: (703) 998-3500

CNA

7 August 1981

MEMORANDUM FOR DISTRIBUTION LIST

Subj: Center for Naval Analyses Research Contribution 447

Ref: (a) CNS 1157, "Ship Overhaul Effectiveness"

Encl: (1) CRC 447, "A Comparison of CASREPs and Engineering Logs in Measuring Ship Material Condition," by John A. Berning, April 1981

1. Enclosure (1) is forwarded as a matter of possible interest.

2. This Research Contribution is motivated by the widespread use of Navy Casualty Report (CASREP) data as a measure of ship material condition. In the "Ship Overhaul Effectiveness Study," reference (a), this measure was used. An effort was also made to develop a different measure, based on ship log data. This was done because of widespread belief in the accuracy of ships' logs. A comparison of the two measures was made in the study. It is elaborated on here because of its independent interest.

3. Research Contributions are distributed for their potential value in other studies and analyses. They do not necessarily represent the opinion of the Department of the Navy.

STANLEY A. HOROWITZ
Director
Institute of Naval Studies

an affiliate of the University of Rochester

Subj: Center for Naval Analyses Research Contribution 447

DISTRIBUTION LIST

SNDL Part I:

21A1	CINCLANTFLT
21A2	CINCPACFLT
21A3	CINCUSNAVEUR
22A1	COMSECONDFLT
22A2	COMTHIRDFLT
22A2	COMSEVENTHFLT
22A3	COMSIXTHFLT
24D1	COMNAVSURFLANT
24D2	COMNAVSURFPAC
24F	COMNAVLOGPAC
24G1	COMSUBLANT
24G2	COMSUBPAC
26F1	COMOPTEVFOR
26F2	DEPCOMOPTEVFORPAC
28A1	COMCARGRU 2
28A1	COMCARGRU 4
28A1	COMCARGRU 6
28A1	COMCARGRU 8
28A2	COMCARGRU 1
28A2	COMCARGRU 3
28A2	COMCARGRU 5
28A2	COMCARGRU 7
28B1	COMCRUDESGRU 2
28B1	COMCRUDESGRU 8
28B1	COMCRUDESGRU 12
28B2	COMCRUDESGRU 1
28B2	COMCRUDESGRU 3
28B2	COMCRUDESGRU 5
41A	COMSC

SNDL Part II:

A1	ASST SECNAV (MRA&L)
A1	ASST SECNAV (RES)
A1	ASST SECNAV (FM)
A2A	NAVCOMPT
A2A	ONR
A2A	OPA
A4A	CHNAVMAT
B2A	SECDEF
B3	NDU
B3	AFSC
B5	COMDT COGARD
C37A2	Annapolis Lab, DTNSRDC
C37A2	Carderock Lab, DTNSRDC
E3A	NRL
FF38	USNA, Nimitz Library
FF44	NAVWARCOL
FJ18	NAVMILPERSCOM
FKA1B	ELECSYSCOMHQ
FKA1G	SEASYSCOMHQ
FKA6A3A	DTNSRDC
FKA6A16	NAVPERSRANDCEN
FKP1G	NAVSHIPWPNSYSENGSTA
FT73	NAVPGSCOL

OpNav: Op-09BH, Op-96, Op-095, Op-098, Op-01, Op-02, Op-03, Op-04, Op-43, Op-06, Op-64

Other

Under Sec'y of Defense, Research and Engineering
Ass't Sec'y of Defense, Program Analysis & Evaluation (2 copies)
Ass't Sec'y of Defense, Manpower, Reserve Affairs & Logistics
Defense Logistics Studies Information Exchange (2 copies)
Defense Technical Information Center (12 copies)
Navy Tactical Support Activity
Institute for Defense Analyses

CRC 447 / April 1981

A COMPARISON OF CASREPs AND ENGINEERING LOGS IN MEASURING SHIP MATERIAL CONDITION

John A. Berning, Jr.

Institute of Naval Studies

CENTER FOR NAVAL ANALYSES

2000 North Beauregard Street, Alexandria, Virginia 22311

TABLE OF CONTENTS

INTRODUCTION

An increasingly important concern to the Navy is the ability to measure readiness. This concern applies to a wide range of Navy operations, and in each case, readiness is very difficult to quantify.

A particular instance of this concern is ship readiness, or even, as a step toward this, ship material condition. No satisfactory measure of material condition is available, either in an absolute or a relative sense, for use in comparing ships.

In the Ship Overhaul Effectiveness Study, a number of Navy reporting systems and inspection results were to be used on a widespread basis to derive approximate indicators of material condition [1 and 2]. All the specific, quantitative results in the study were to be in terms of these indicators.

Of the indicators developed for the study, those based on Casualty Reports (CASREPs) were expected to be the most reliable. In an effort to understand how good these might be, however, ships' engineering smooth logs were examined on a limited basis, particularly with a restriction to FF-1052 class ships, and a material condition variable, engineering log downtime, was derived.

In this paper, an analysis is made which compares CASREP downtime and engineering log downtime. A careful description of these variables is given before the actual analysis is discussed.

The study itself considered a variety of ship systems. These are shown in table 1. Only certain of these are reflected in engineering logs. Specifically, hull structure, sonar and interior communications are not; the remaining systems are all studied here.

Table 1 also shows the definitions of the systems by equipment identification code (EIC). These are needed for the assignment of CASREPs to the systems. In the table, an EIC with zeros at the end and followed by an s is used to denote all EICs with the zeros replaced by letters or numbers. For example, "AB00s" represent all EICs beginning with "AB." Where the word "some" appears, it means that the CASREP word description was used to further aid the classification into systems.

TABLE 1

SURFACE SHIP SYSTEMS:
DEFINITION BY EQUIPMENT IDENTIFICATION CODE (EIC)

System	EIC
Whole ship	all
Hull structure	AA00s, AB00s, AD00s, A000-A600s, A800-A900s
Main propulsion	B000s, C000s, F000s, K000s
Propulsion shafting	B400-B406, C400-C406, FE00-FE05, KD00-KD05
Main steam piping	F700s
Feed and condensate	F300s, K300s, some K700s
Propulsion boilers	F100, F101, F104, some F701, some F703
Combustion air	F400, F401, F403
Electrical	EC00s, KG00s, some 3000s, some 4000s
Power generators	3000, 3100-3107, 310C-310E
Sonar	R000s except R500-R800s, AF00, AF01
Interior communications	M000s, M300s, M400s, 410E, 410F, 410G
Climate control	T100s, T300s, T400s
Refrigeration	T500s
Distilling plant	TK00s
Compressed air	TF00s, N700s
Steering	some TL00s

ENGINEERING LOG VARIABLE

A ship's engineering smooth log is a record required to be maintained daily and to be retained for at least three years. Among the entries in the log each day is a midwatch entry, stating the ship's location and activity, and the major equipments in the engineering system which are currently on line and those which are out of commission (OOC).

As an indicator of material condition, we tallied from these logs the number of equipments listed as OOC. The tallies were made over three month periods, and were organized by systems within the engineering area. We interpret the number of entries in the OOC listing as the number of days of equipment downtime. This is the engineering log variable for an engineering system in a three month period, or quarter.

Engineering logs are apt to be reliable, as they are official, legal documents and as the entries are easy to make. Moreover, the logs, and therefore our variables, represent a nearly continuous record of equipment condition.

However, there is no entirely specific policy on what equipments must be logged. This leads to some inconsistency between ships and even between periods for the same ship. The listing of some smaller equipments may reflect the interest or specialty of the person filling in the log. Moreover, there is ordinarily no description of the scope or criticality in an OOC entry, so that it may not be possible to distinguish equipments down for preventative maintenance. This suggests that our variable may be an overestimate of problems in material condition.

Finally, as the logs are required to be maintained only onboard ship and only for three years back, there is considerable difficulty in getting at them. Certainly we were not able to calculate our variable on the widespread basis that we would have liked. Nevertheless, this variable was a central and important one in the study. The ships and months for which we have log data are shown in table 2.

TABLE 2

SHIP MONTHS FOR THE ENGINEERING LOG VARIABLE

Hull number	Ship	Number of months
FF 1054	USS Gray	12
FF 1055	USS Hepburn	15
FF 1058	USS Meyerkord	31
FF 1059	USS W.S. Sims	12
FF 1060	USS Lang	15
FF 1061	USS Patterson	12
FF 1062	USS Whipple	14
FF 1063	USS Reasoner	33
FF 1066	USS Marvin Shields	24
FF 1068	USS Vreeland	14
FF 1070	USS Downes	24
FF 1072	USS Blakely	34
FF 1075	USS Trippe	12
FF 1076	USS Fanning	17
FF 1077	USS Quellet	11
FF 1079	USS Bowen	16
FF 1080	USS Paul	12
FF 1084	USS McCandless	15
FF 1088	USS Barbey	15
FF 1092	USS Thomas S. Hart	14
FF 1095	USS Truett	12
FF 1096	USS Valdez	12
DDG 13	USS Hoel	29
		405

CASREP VARIABLES

Casualty Reports (CASREPs) are filed when a deficiency in an essential equipment causes a degradation in one of a ship's primary mission areas. A report must be filed if the deficiency requires outside assistance to correct or if it is expected to persist for 96 hours (possibly less). The reports as finally submitted include, among other information, the beginning and ending times of the casualty, the amount of time in this interim waiting for needed parts, the cause of the casualty, and the equipment identification codes (EIC) of the deficient equipment. In addition, there is a word description of the equipment deficiency and an assessment of the level of degradation, which is from a satisfactory condition level C1 to one of the increasingly degraded levels C2, C3, or C4.

From the records of a ship's CASREPs, we calculated for the study itself several variables as indicators of material condition. One is the number of occurrences, i.e., the number of CASREPs filed. A second is the total sum of all CASREP equipment downtimes. A third is the sum of CASREP downtimes due to maintenance; that is, the total downtime less the amount of supply time.

Each of these variables was computed by system and by month. Moreover, each was computed by considering only C3 and C4 CASREPs together, and by considering all C2, C3 and C4 CASREPs. We use both of these for CASREP total downtime in this paper.

CASREP data as an indication of material condition is apt to be more reliable than many other sources for several reasons. CASREPs are official reports which receive a high level of attention. Consequently, greater care is taken in filing them and they are likely to be more accurate. The reports do contain the detailed information mentioned before, and they apply to all essential equipment.

CASREP data, however, may be an inconsistent indicator of material condition. This would largely be due to the inherent subjectivity in deciding on the level of degradation of an equipment deficiency. These decisions would also be affected by the changing policies, between type commanders and over years, regarding emphasis on CASREP reporting. Also, a reluctance to attribute a casualty to personnel error may result in improper reporting of the cause of a CASREP.

In our use of CASREP data, considerable care was taken in editing the reports. In particular, we carefully checked the match between EIC and equipment word description to get the CASREP in the proper system. This should largely remedy potential reporting mistakes.

ANALYSIS

The analysis in this paper centers on a comparison of the log data with CASREP total downtime data. It is made on those systems for which material condition would be reflected in the engineering log.

In obtaining the log data, there was considerable difficulty in assigning entries to either the propulsion shafting or main steam piping systems. Far too often, log entries were too vague to make a dependable decision in assignment in these systems. For this reason, the log data on these systems is considered unreliable, and is not included in the analysis.

A first step in the analysis was to construct graphs for each of the systems. These graphs plot, for each system, engineering log downtime days, CASREP C3-C4 downtime in days, and CASREP C2-C3-C4 downtime in days, for successive quarters after overhaul. Quarters were employed because they were the periods used in acquiring the log data.

These graphs were constructed only for those ships with seven or more quarters of log data. Those ships are: USS Meyerkord, FF-1058; USS Reasoner, FF-1063; USS Marvin Shields, FF-1066; USS Downes, FF-1070; USS Blakely, FF-1072; and USS Hoel, DDG-13. All other ships had only five or fewer quarters available, and this was felt to be too few to plot. These graphs are presented in the appendix, together with an analysis of them.

Observations from the graphs may be summarized as follows. There is a noticeable correlation in periods of high and low downtime between engineering logs and CASREPs. Log downtime is typically greater than CASREP downtime, so that CASREP C2-C3-C4 downtime is a closer approximation than C3-C4 downtime. Also, the observed correlation is far better for the main propulsion and electrical systems and subsystems. It is erratic for the auxiliary systems, being reasonably good for compressed air and quite poor for steering and especially refrigeration. Finally, these characteristic observations are as prevalent for the one DDG as for the FFs.

In order to quantify the generally observed parallels between CASREP and log downtimes, the statistical correlations between them were calculated. These correlations, with their significance levels, are given in table 3. In computing these correlations, the log data from all the FFs was used. The DDG data was not included, however, to avoid possible complications from having different ship types in the one analysis. The correlations themselves measure the extent to which log downtime and CASREP downtime vary together above or below their respective average values.

TABLE 3

CORRELATIONS OF ENGINEERING LOG DAYS WITH CASREP HOURS DOWNTIME[a]

System	Correlation (significance level) eng log days with CASREP C3-C4 hours	Correlation (significance level) eng log days with CASREP C2-C3-C4 hours
Whole ship	--	--
Hull structure	--	--
Main propulsion	.63 (.001)	.52 (.001)
Propulsion shafting	.15 (.039)	.03 (.355)
Main steam piping	-.02 (.417)	-.04 (.308)
Feed and condensate	.50 (.001)	.45 (.001)
Propulsion boilers	.49 (.001)	.48 (.001)
Combustion air	.54 (.001)	.43 (.001)
Electrical	.42 (.001)	.45 (.001)
Power generators	.51 (.001)	.51 (.001)
Sonar	--	--
Interior communications	--	--
Climate control	.17 (.022)	.28 (.001)
Refrigeration	-.01 (.468)	-.04 (.315)
Distilling plant	.26 (.001)	.36 (.001)
Compressed air	.37 (.001)	.54 (.001)
Steering	.01 (.455)	.24 (.002)

[a]Based on 137 ship-quarters.

The correlations shown in table 3 support the observations made from the graphs in the appendix. Most systems show a substantial correlation between CASREP and log downtime. The correlation generally ranges from .4 to .5. Moreover, these estimates have a very high significance, usually .001, indicating the virtual certainty of some amount of correlation.

It may be observed that propulsion shafting and main steam piping have extremely low correlations. This is consistent with the earlier remarks on the unreliability of their engineering log data. No further attention is given to them.

Again, the systems and subsystems coming from main propulsion and electrical have the highest correlations. It may be noted that among these systems, C3-C4 CASREP downtime often correlates more highly than

all CASREP downtime. Less consistency in C2 CASREP reporting would account for this higher correlation. It was observed earlier that all C2-C3-C4 CASREP downtime was closer to log downtime in actual magnitude.

The auxiliary systems show a generally lower and less consistent pattern of correlation. Refrigeration and steering have particularly low correlations, and probably indicate an unreliable correspondence. Certainly this is so for refrigeration. Compressed air has the highest correlation, and is actually comparable to the main propulsion and electrical systems. Among the auxiliary systems, all C2-C3-C4 CASREP downtime has a higher correlation with log downtime.

Table 4 shows the average downtime days per quarter for engineering logs and C2-C3-C4 CASREPs in the various systems. These average values come from the observed sample. In all cases except steering, the engineering log value is considerably higher than the CASREP one.

TABLE 4

AVERAGE VALUES OF ENGINEERING LOG DAYS AND CASREP C2-C3-C4 DOWNTIME DAYS[a]

System	Mean (stnd dev) eng log OOC days/qtr		Mean (stnd dev) CASREP C2-C3-C4 days/qtr	
Whole ship	--		456.4	(316.6)
Hull structure	--		2.8	(10.6)
Main propulsion	180.5	(147.4)	67.5	(86.7)
Propulsion shafting	0.5	(1.9)	0.4	(2.4)
Main steam piping	8.3	(20.9)	1.8	(7.2)
Freed and condensate	47.5	(56.1)	14.8	(27.9)
Propulsion boilers	57.8	(51.3)	25.7	(43.7)
Combustion air	25.8	(39.8)	11.0	(26.7)
Electrical	72.4	(59.6)	27.3	(38.9)
Power generators	52.6	(53.4)	14.5	(26.0)
Sonar	--		35.7	(42.9)
Interior communications	--		1.3	(11.6)
Climate control	32.3	(34.8)	14.5	(24.6)
Refrigeration	7.3	(16.0)	0.3	(2.4)
Distilling plant	23.5	(31.4)	4.6	(15.5)
Compressed air	87.6	(80.7)	27.5	(38.5)
Steering	1.9	(5.3)	2.1	(9.8)

[a]Based on 137 ship-quarters.

A more penetrating observation, however, concerns the relative magnitudes between systems. In view of the earlier discussion, propulsion shafting and main steam piping are ignored. Aside from these, the main propulsion and electrical systems exhibit a noticeable pattern of generally higher downtime days than the auxiliary systems. Among the latter, steering and refrigeration are the lowest, while compressed air is comparable with the former systems. This suggests that the systems whose engineering log and CASREP downtimes correlate best are the ones with the greater amounts of downtime. It may be that there is a certain amount of noise in engineering logs and CASREPs which a low level of downtimes is insufficient to distinguish.

Table 5 shows the results of some further analysis; this involves the prediction of engineering log downtime from C2-C3-C4 CASREP downtime. The analysis begins with a model which assumes that engineering log downtime (ELD) can be expressed as a linear function of CASREP downtime (CRD). The explicit equation for this model may be written as

$$ELD = a + b \quad CDR .$$

TABLE 5

COEFFICIENTS FOR PREDICTION OF
ENGINEERING LOG DAYS FROM CASREP C2-C3-C4 DOWNTIME DAYS[a]

System	Constant	Coefficient	(t-value)
Whole ship			
Hull structure			
Main propulsion	121.1	0.88	(7.0)
Propulsion shafting			
Main steam piping			
Feed and condensate	34.0	0.91	(5.9)
Propulsion boilers	43.3	0.56	(6.4)
Combustion air	18.8	0.64	(5.5)
Electrical	53.4	0.70	(5.9)
Power generators	37.4	1.06	(6.9)
Sonar			
Interior communications			
Climate control	26.4	0.40	(3.4)
Refrigeration	7.4	-0.28	(0.5)
Distilling plant	20.2	0.72	(4.4)
Compressed air	56.5	1.14	(7.5)
Steering	1.6	0.13	(2.9)

[a]Based on 137 ship-quarters.

The constant a and coefficient b are determined statistically from the data, and the results are the entries in table 5. The t-values shown there reflect the reliability of the relationship expressed by the coefficient. All the relationships shown except refrigeration and steering have a significance of at least .001, indicating overwhelming evidence for some relationship. Steering is reliable at a .01 level, while refrigeration must be taken as unreliable.

The values in table 5 may give insight into the broad correspondence between engineering log and CASREP downtimes. Some thought suggests two basic, though quite different, possibilities for this correspondence.

One possibility is that CASREP downtime is always some fraction of engineering log downtime. This fraction could of course differ by system. In any case, however, the constant a in the above equation would be close to 0, and the coefficient b would give the multiple needed to get log downtime from CASREP downtime. This seems very clearly not to be the case. Examination of tables 4 and 5 shows that in fact the constant is a substantial fraction of the average log downtimes and not close to 0.

The other basic possibility is that there is always a threshold level of engineering log downtime not captured by CASREPs, and that downtime above this is reflected equally by engineering log entries and by CASREPs. In this case, the above equation would have a value of 1 for the coefficient b. Examination of table 5 shows that the coefficients are in fact quite close to 1. Due to limitations in the data sources and the data collection, they cannot be expected to be exactly 1. However, for main propulsion, feed and condensate, and power generators, the hypothesis that they are 1 cannot be rejected even for a significance level as low as .60. For this same significance level, the hypothesis that the coefficient b is equal to .75 cannot be rejected for any of the main propulsion or electrical systems except propulsion boilers and power generators.

Greater deviation from 1 takes place among the auxiliary systems. In particular, the hypothesis of a coefficient close to 1, and the explanation it is based on, cannot be said to hold for steering and refrigeration. Climate control is uncertain. The evidence is more convincing for the other systems, though not conclusive.

SUMMARY

A general and fundamental concern centers on how well CASREPs reflect actual ship material condition. There is at least some feeling that engineering logs maintained onboard ship may be quite good, and in any case are probably best, in reflecting material condition. CASREP downtime has been analyzed here in terms of these engineering logs, for a variety of engineering systems with data from a sample of FF-1052 class ships.

The analysis shows a significant correlation between engineering log downtime and CASREP downtime. Furthermore, it suggests that beyond a threshold minimum of log downtime which CASREPs do not pick up, additional log downtime may be closely reflected by CASREP downtime. In any case, there is quite definitely a large amount of log downtime not picked up by CASREP downtime.

While a significant correlation exists for most systems, it is noticeably better for those systems with larger actual amounts of downtime. Among the systems studied here, those with large amounts of downtime include the main propulsion and electrical systems, and compressed air from within the auxiliary systems. For these systems, the correlation is roughly in the range of .4 to .5. The remaining systems, with small amounts of downtime, show a poorer correlation. It is still often in as high a range as .2 to .3. Refrigeration and steering are extreme cases, with very little downtime and very poor correlation.

Based on this analysis, there is clearly a substantial amount of equipment downtime which is not recorded in the CASREP system. Relatively higher and lower periods of equipment downtime, however, tend to be accurately captured by CASREP downtime. This implies that while CASREPs do not show all equipment problems, they may be accurate in showing relative equipment condition between different ships.

REFERENCES

[1] Study Directive, Ship Overhaul Effectiveness Study, CNO ltr Ser 96/193896 of 19 Nov 1979

[2] Memorandum for the Chairman, Ship Overhaul Effectiveness Study Advisory Committee, (CNA)79-1784, "Study Plan for Ship Overhaul Effectiveness Study," 5 Dec 1979

APPENDIX A

CASREP AND ENGINEERING LOG GRAPHS

APPENDIX A

CASREP AND ENGINEERING LOG GRAPHS

In this appendix, an explicit presentation is given of the correlation between engineering log out of commission days and CASREP downtime days. The presentation is in the form of graphs which plot the sum of all equipment downtime days for each quarter after overhaul.

Each graph is for a single ship and system, and has three plots on it. The dashed line is a plot of downtime, or out of commission days, recorded in the ship's engineering smooth log for successive quarters. The two solid lines are plots of CASREP downtime days for each quarter. The higher solid line includes all C2-C3-C4 CASREPs while the lower one includes only C3-C4 CASREPs. When only one solid line is apparent, it is because the lower one is always zero; that is, because there were no C3-C4 CASREPs.

The presentation of these graphs is limited to only those ships for which seven or more quarters of log data were obtained. These ships are the FF-1058, FF-1063, FF-1066, FF-1070, FF-1072 and DDG-13. All other ships had only five or fewer quarters of log data; this was felt to be insufficient for gaining insight from graphs.

In most cases, the engineering log data even for these six ships does not cover the entire postoverhaul period. Only the period which is covered can be graphed. In two cases, intermediate quarters were also missing; these are the fourth quarter after overhaul for the FF-1070 and the seventh quarter after overhaul for the FF-1072.

The DDG-13 was not included in the correlation analysis discussed in the text. This was to avoid the complication of introducing a different ship type into the statistics. However, its graphs give insight, and can be presented here without this problem.

Examination of figures 1 through 11 reveals a general pattern of correlation between the downtime days from engineering logs and from CASREPs. High periods and low periods of downtimes from the two sources tend to occur together.

Moreover, in regard to magnitude, the engineering logs almost invariably register more downtime. This is particularly so for the main propulsion and electrical systems, and somewhat less so for the auxiliary systems. This tendency implies that all C2-C3-C4 CASREP downtime will more closely approximate engineering log downtime than will only C3-C4 CASREP downtime.

This observation is perhaps to be expected. Equipments may be registered as out of commission in an engineering log even when down for

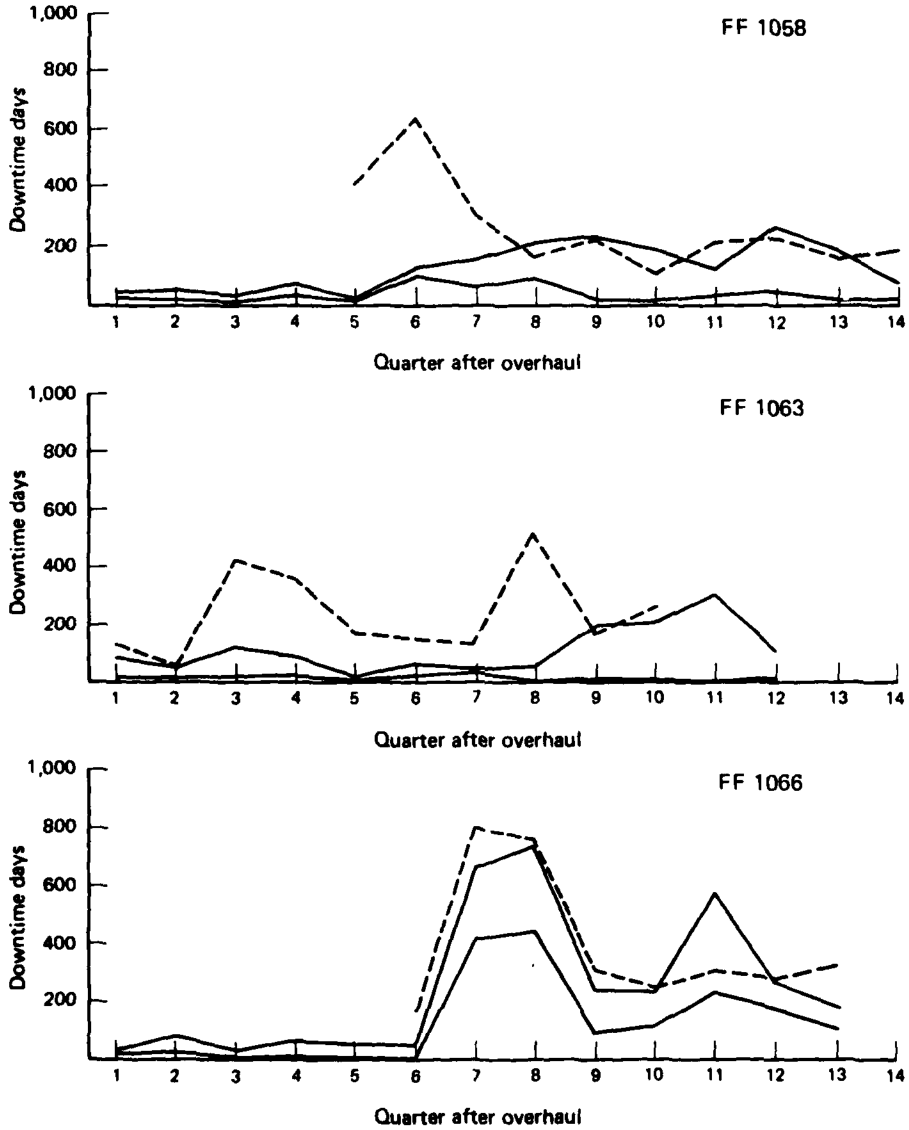


FIG. 1: MAIN PROPULSION DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

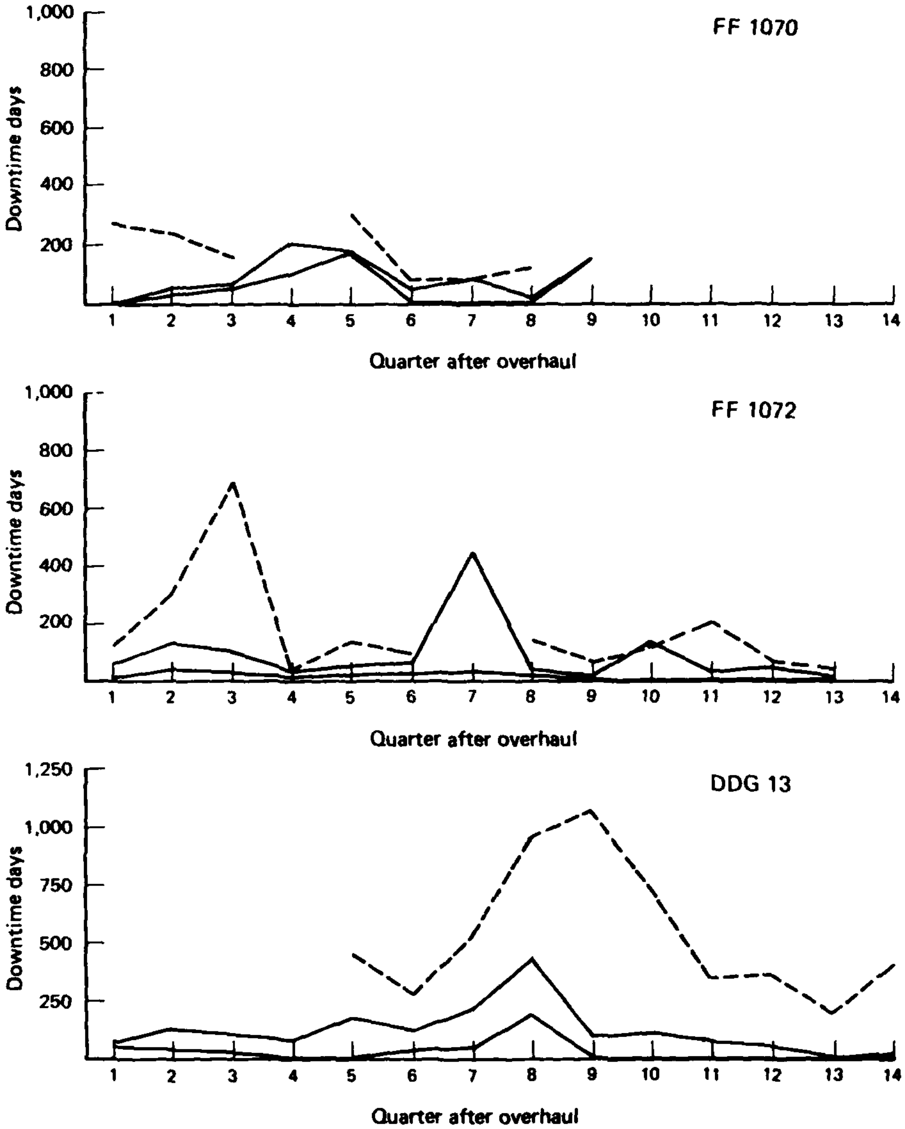


FIGURE 1: (Continued)

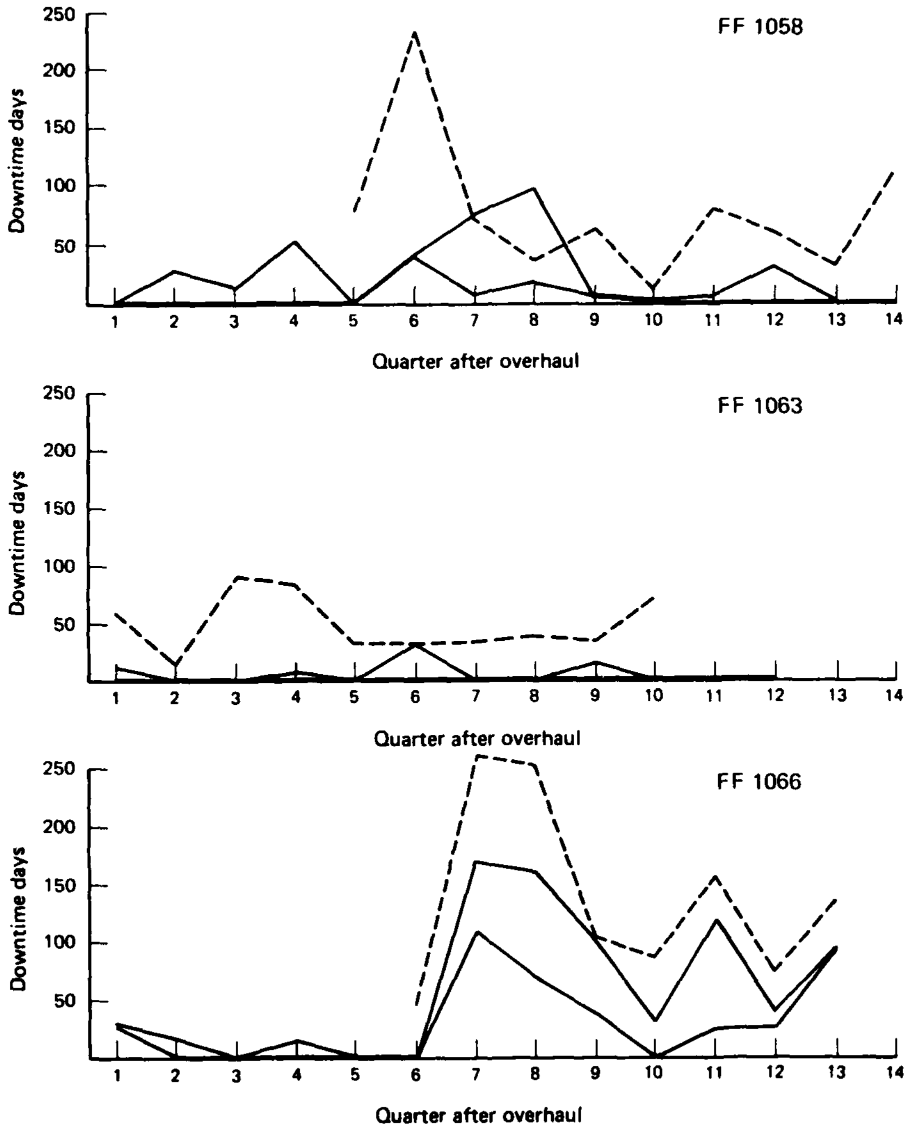


FIG. 2: FEED AND CONDENSATE DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

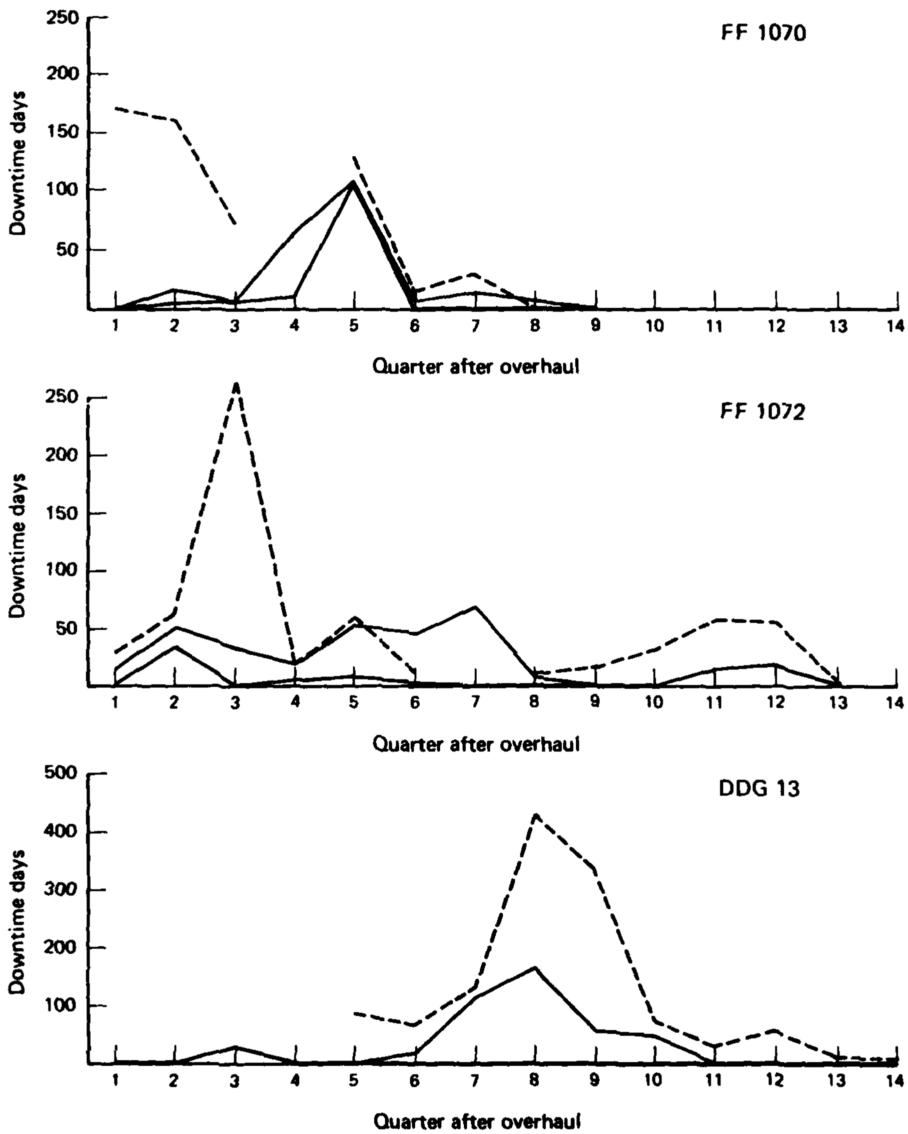


FIGURE 2: (Continued)

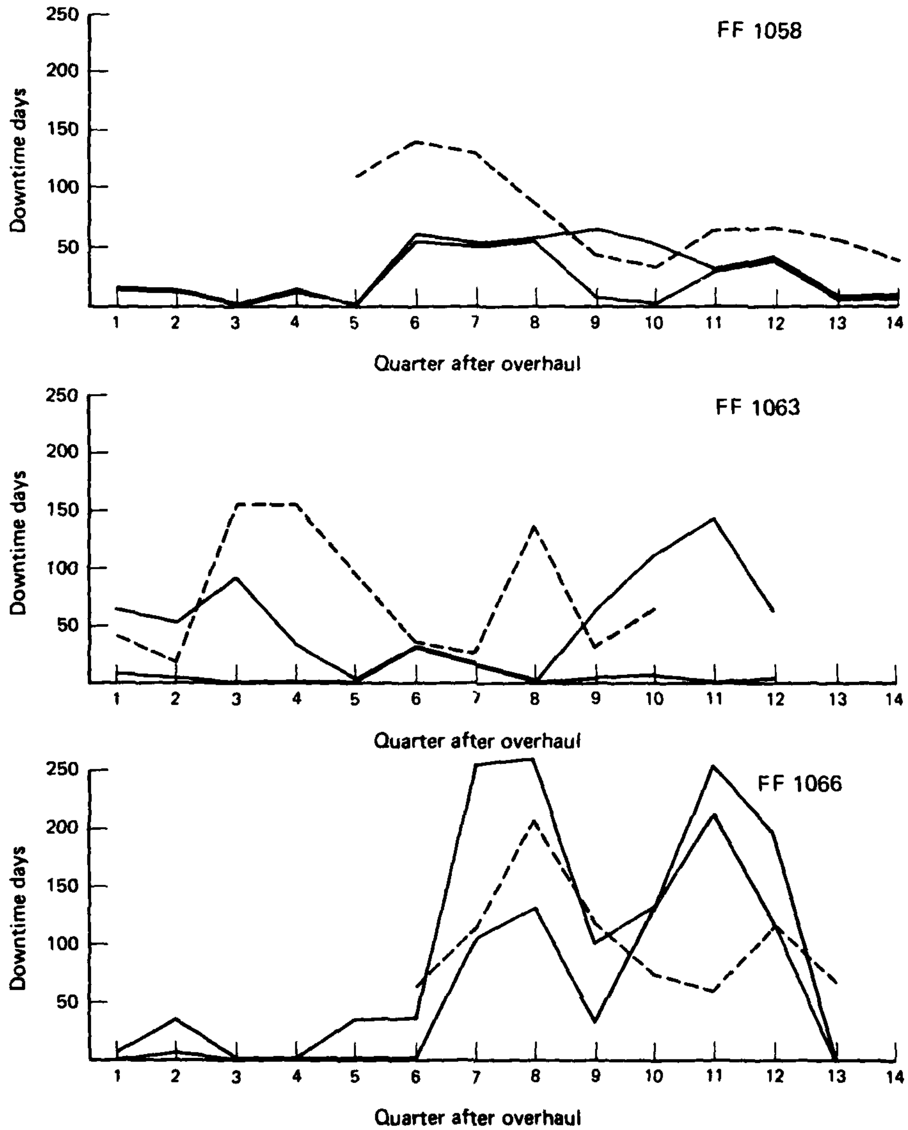


FIG. 3: PROPULSION BOILERS DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

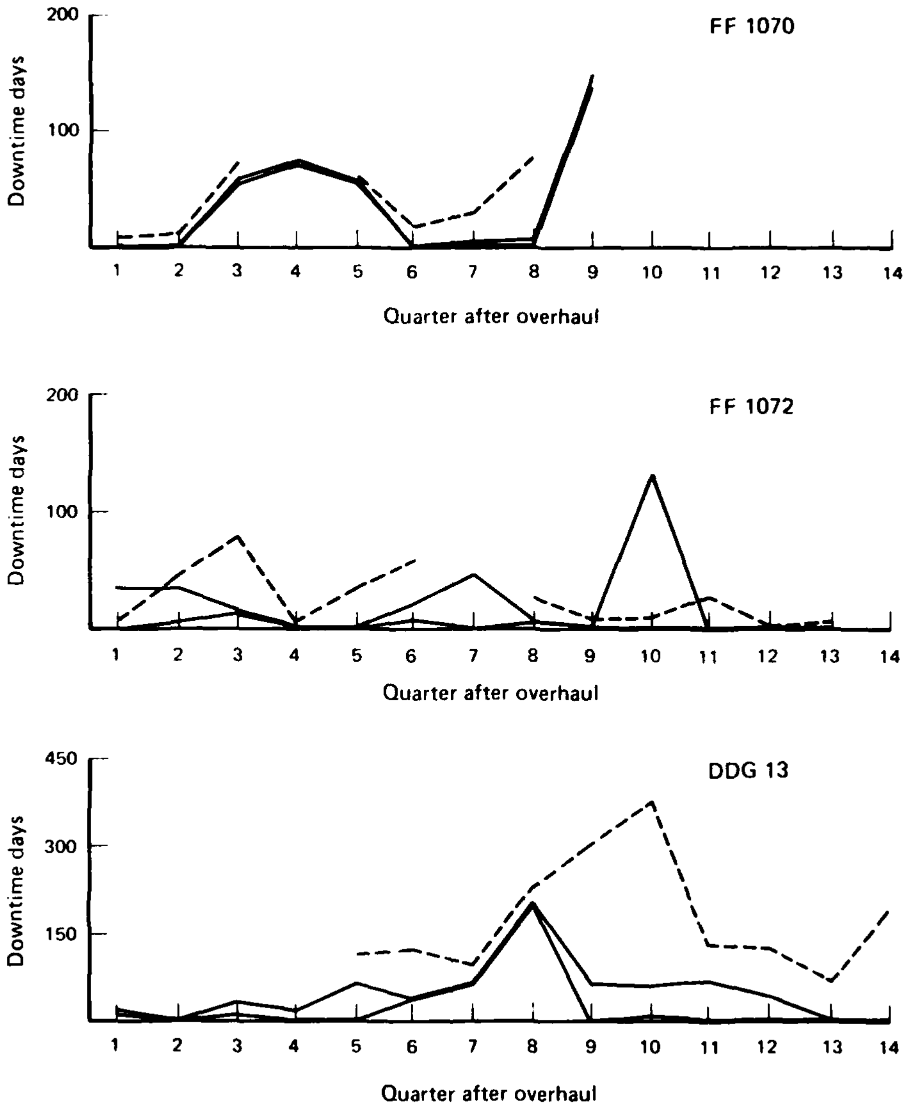


FIGURE 3: (Continued)

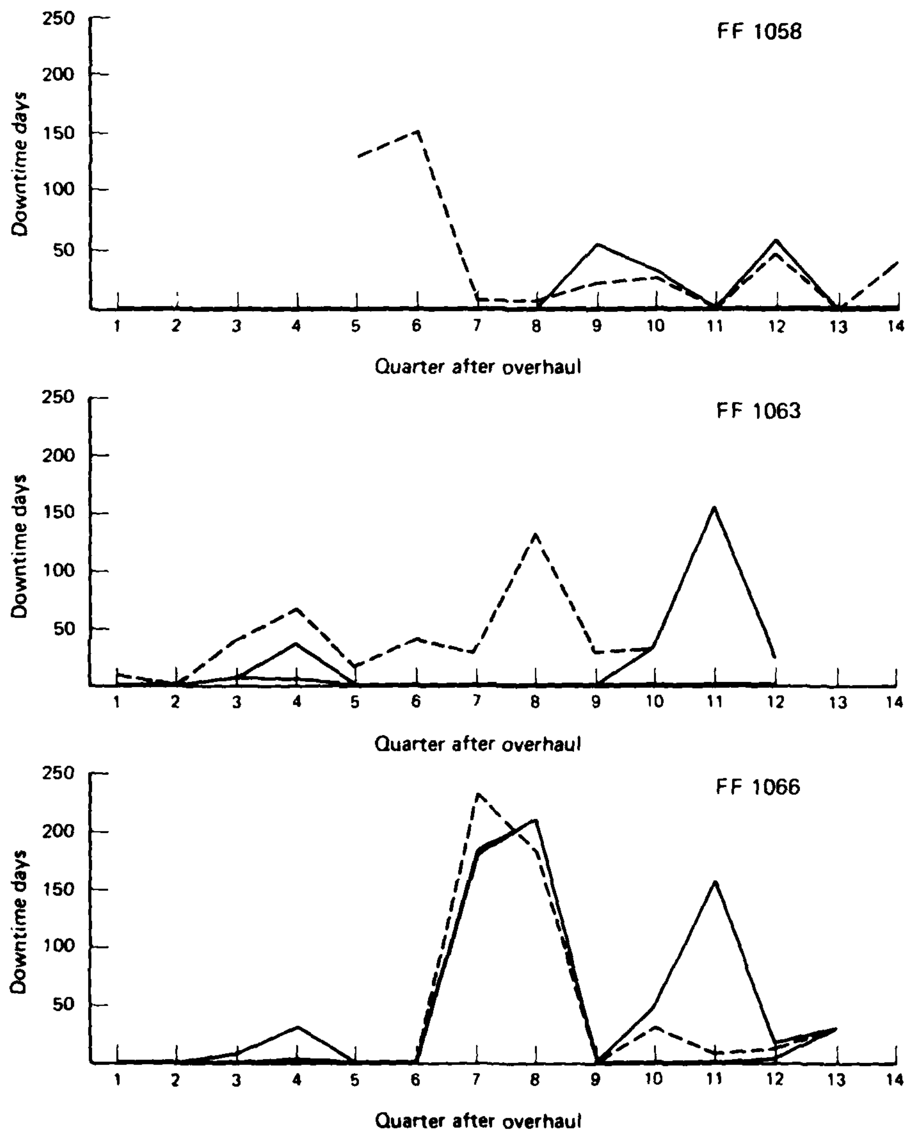


FIG. 4: COMBUSTION AIR DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

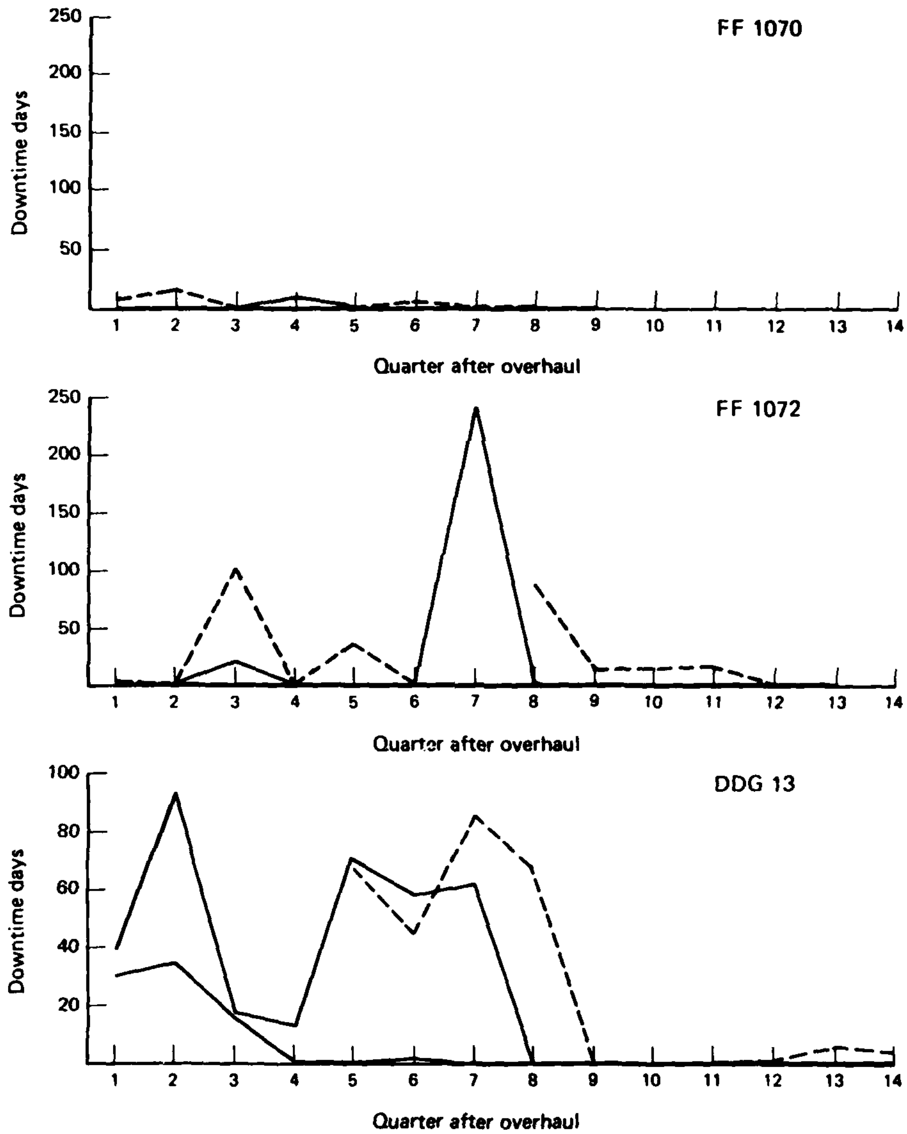


FIGURE 4: (Continued)

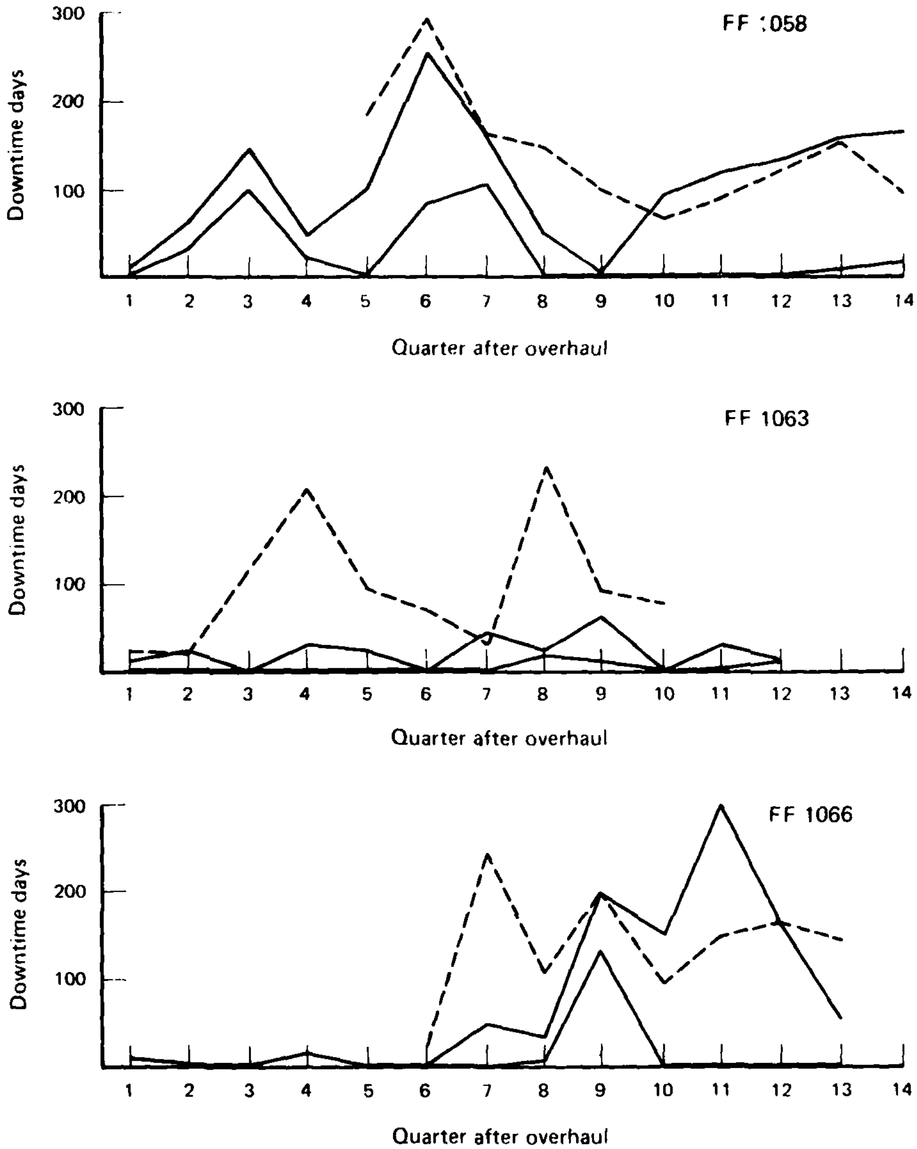


FIG. 5: ELECTRICAL DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

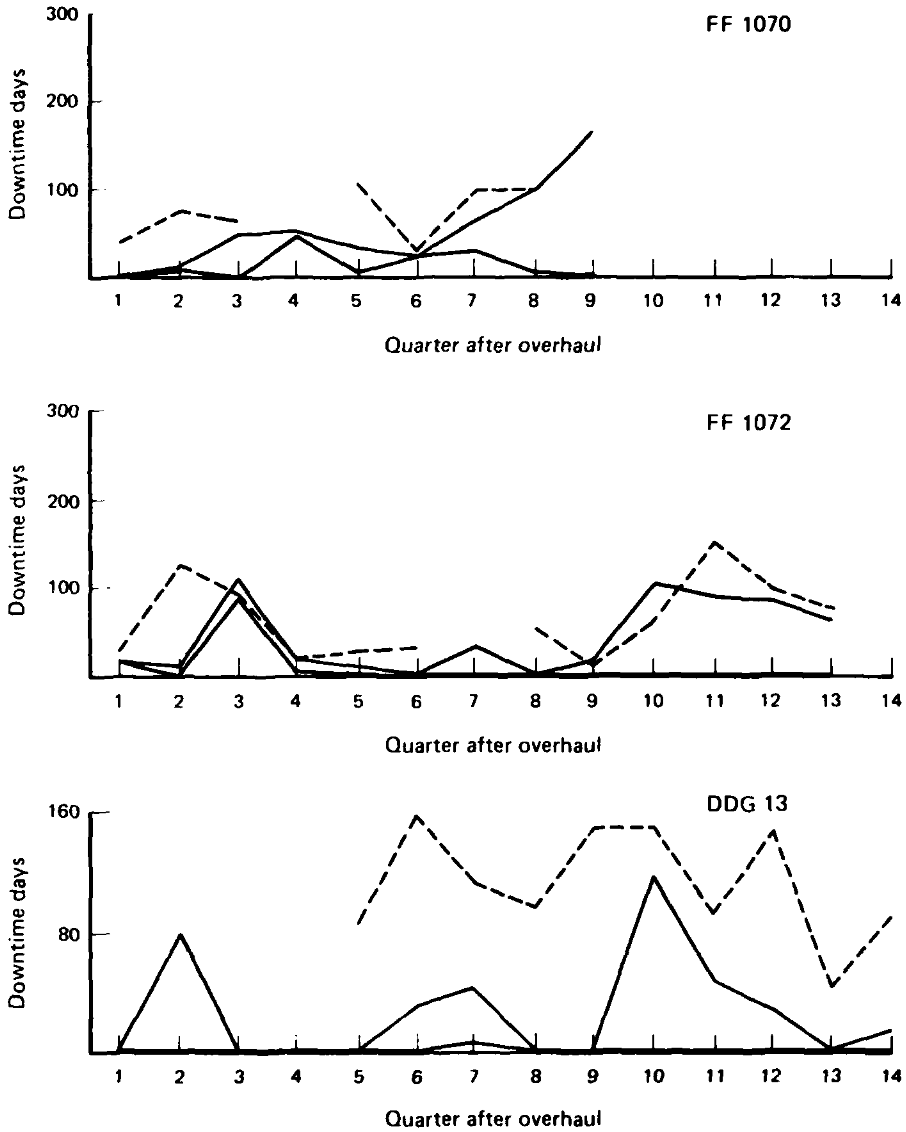


FIGURE 5: (Continued)

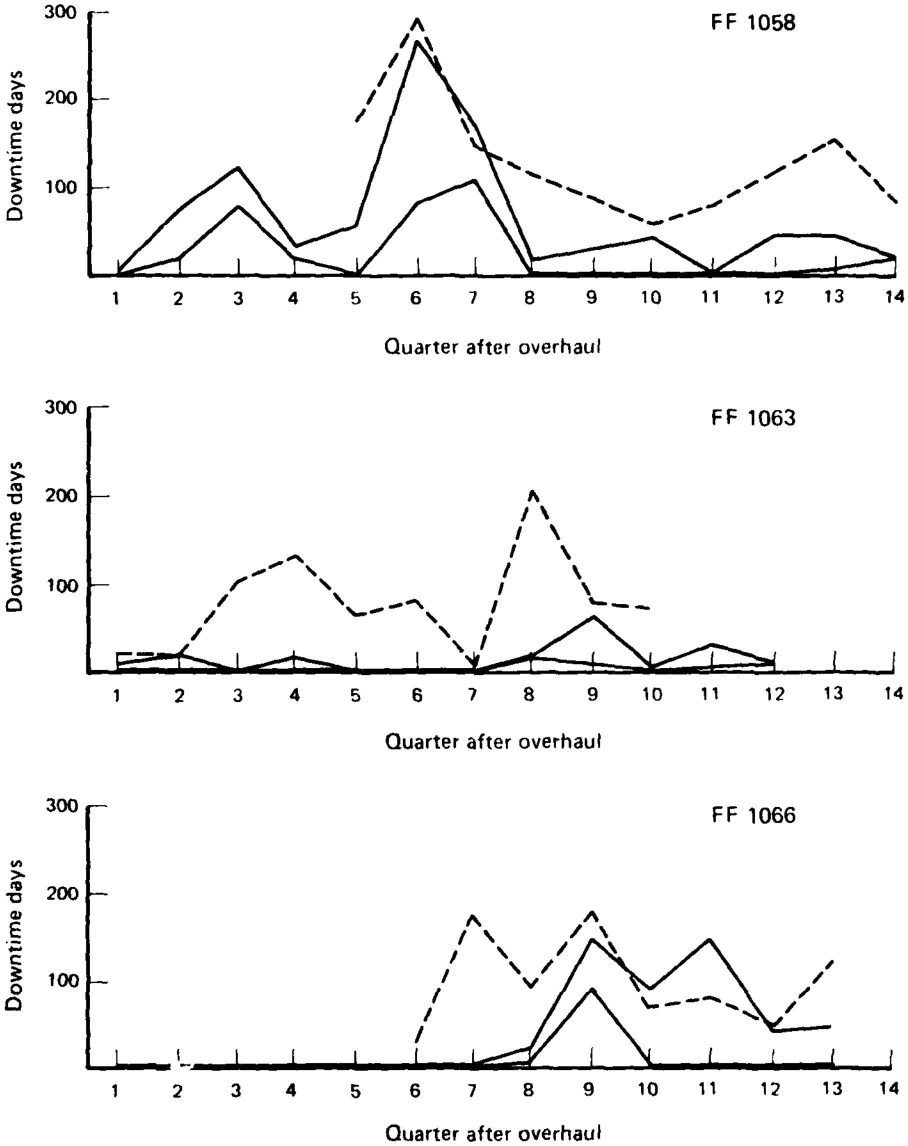


FIG. 6: POWER GENERATORS DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

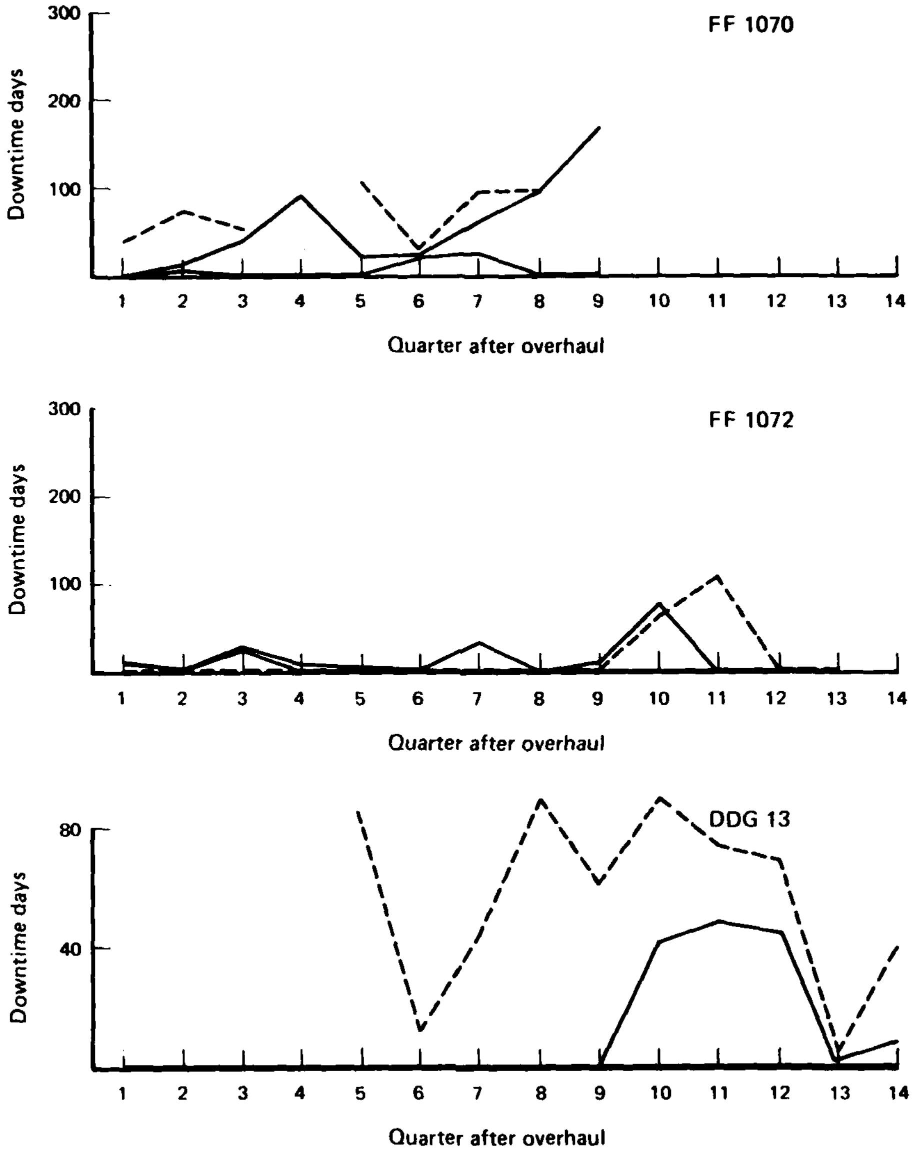


FIGURE 6: (Continued)

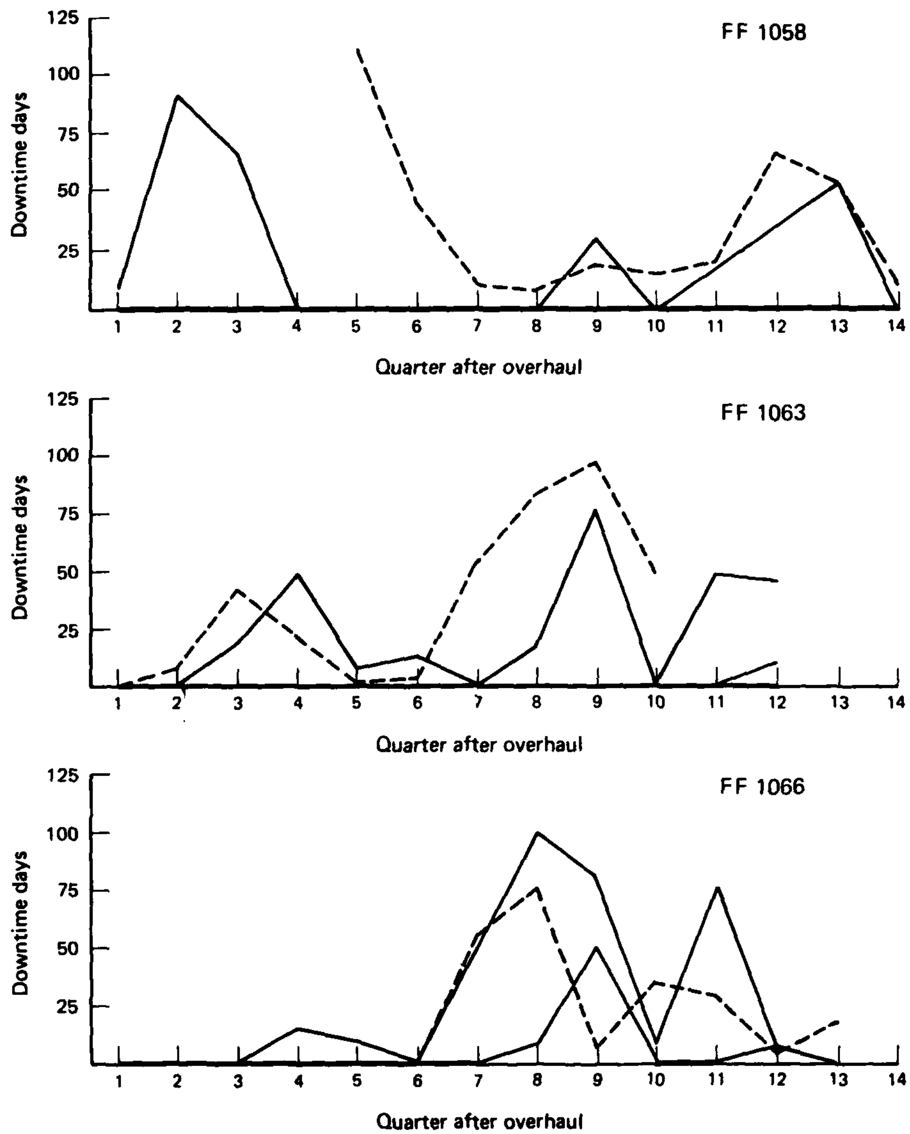


FIG. 7: CLIMATE CONTROL DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

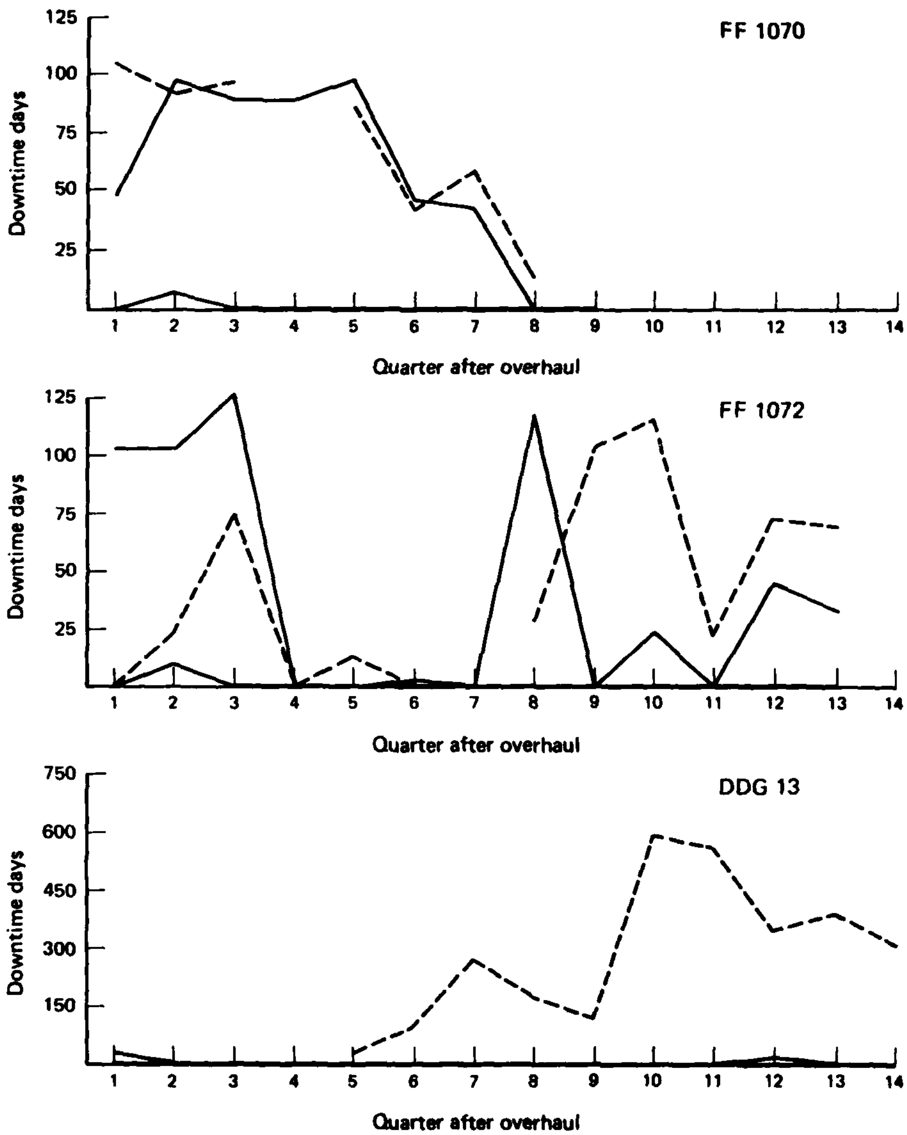


FIGURE 7: (Continued)

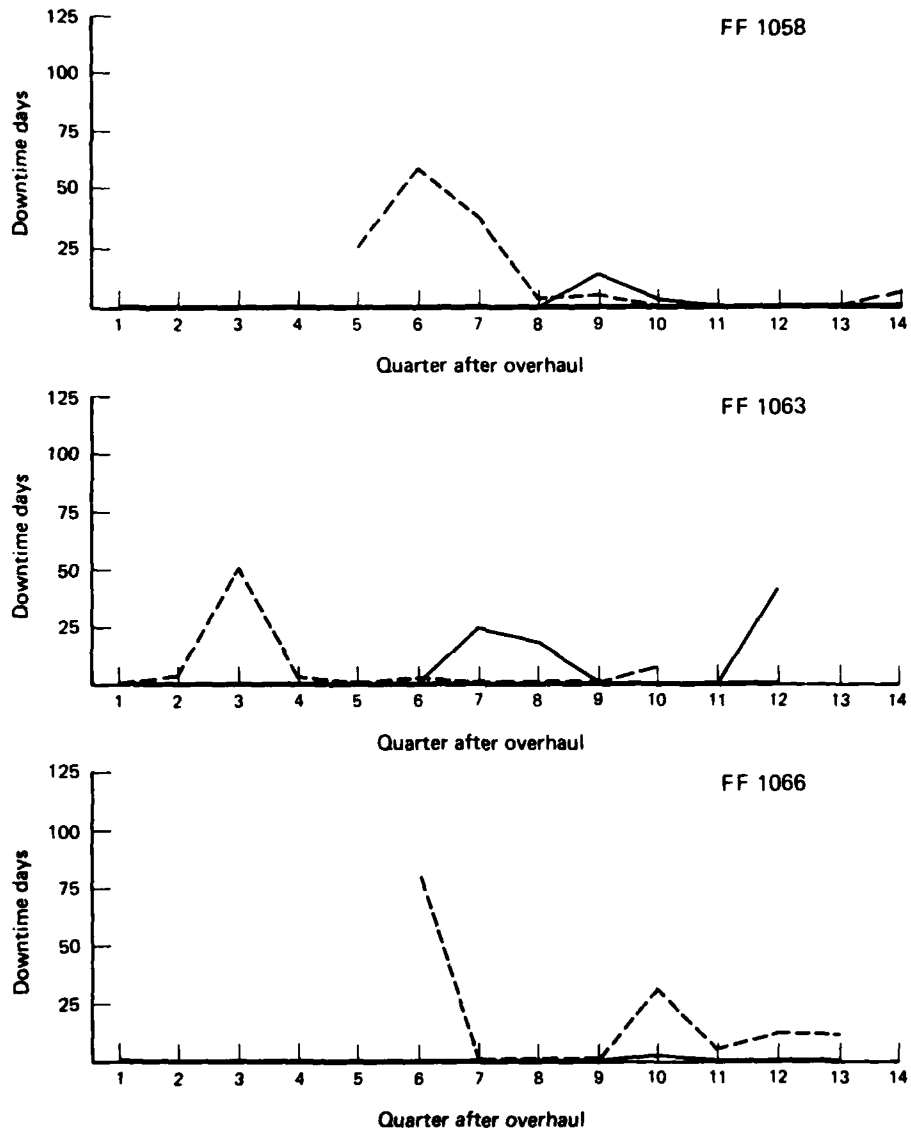


FIG 8: REFRIGERATION DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

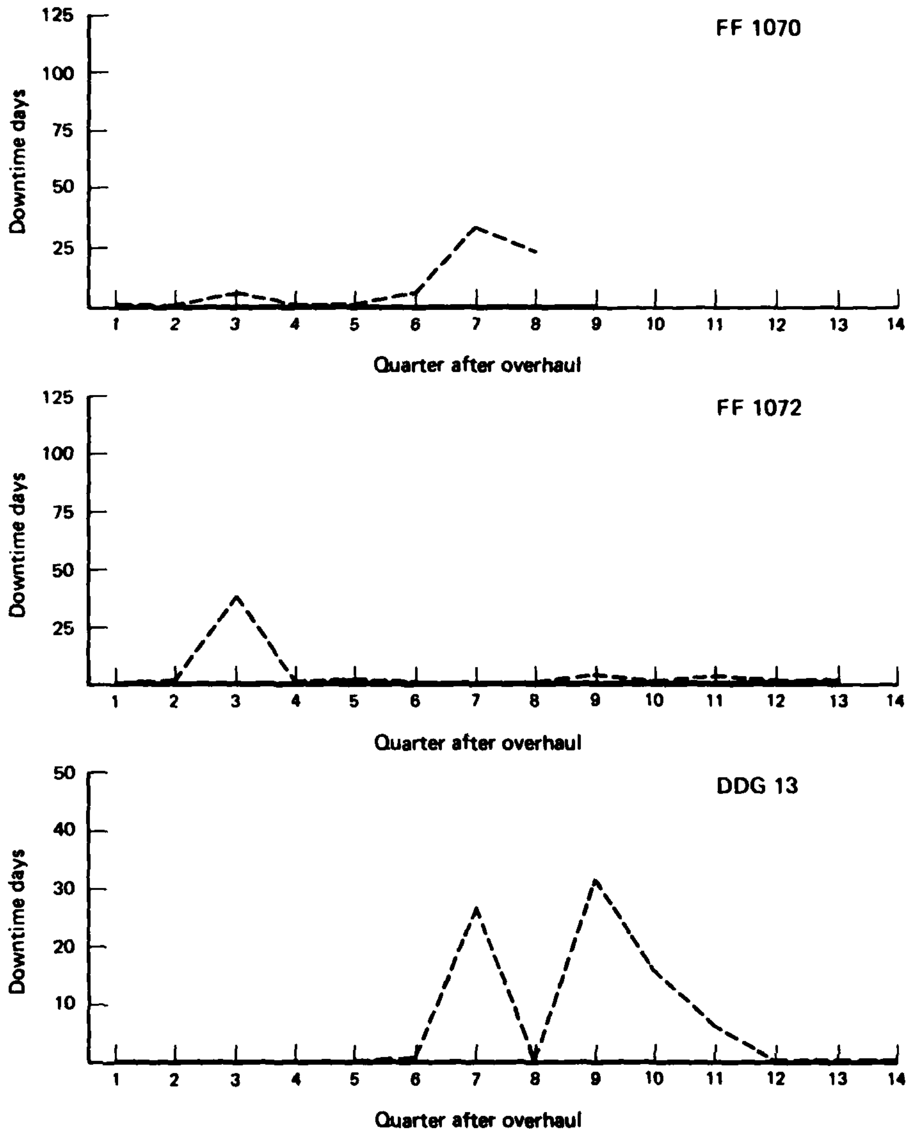


FIGURE 8: (Continued)

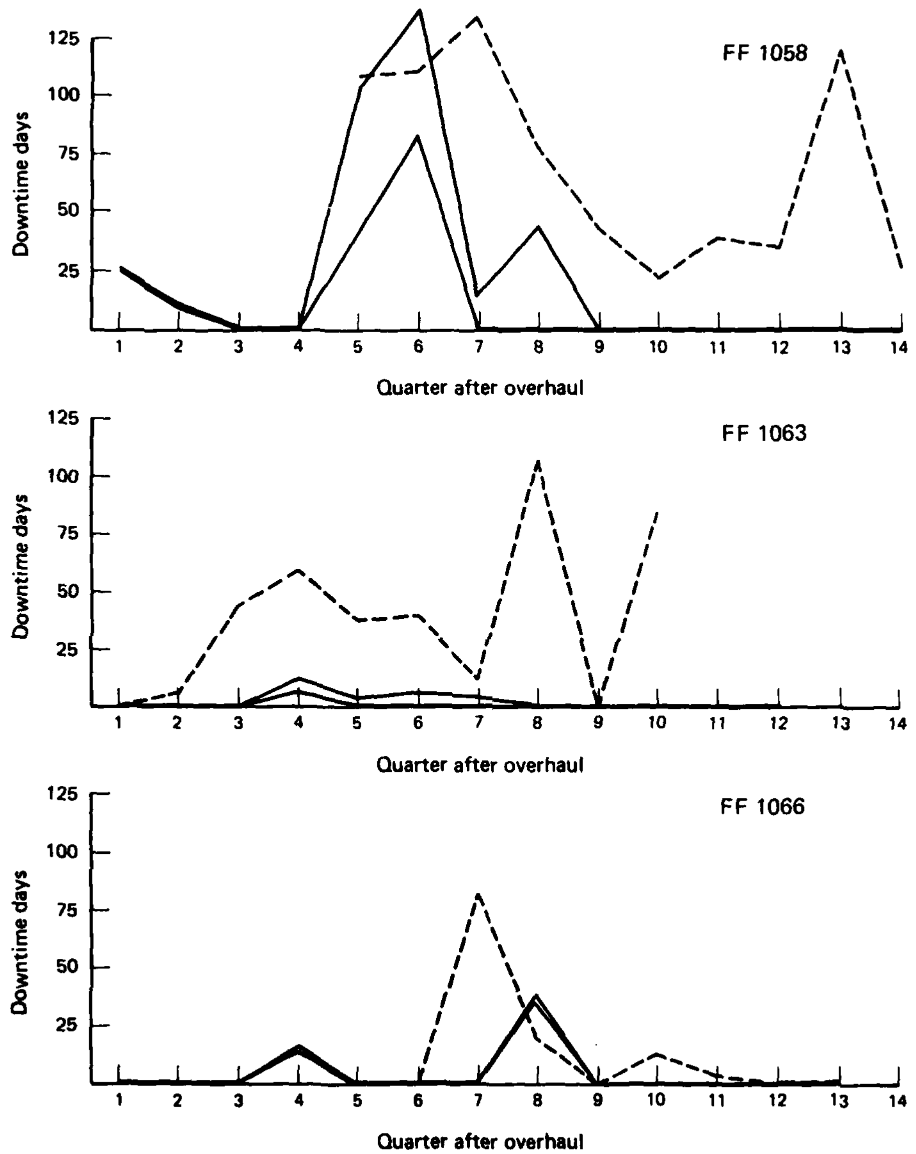


FIG. 9: DISTILLING PLANT DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

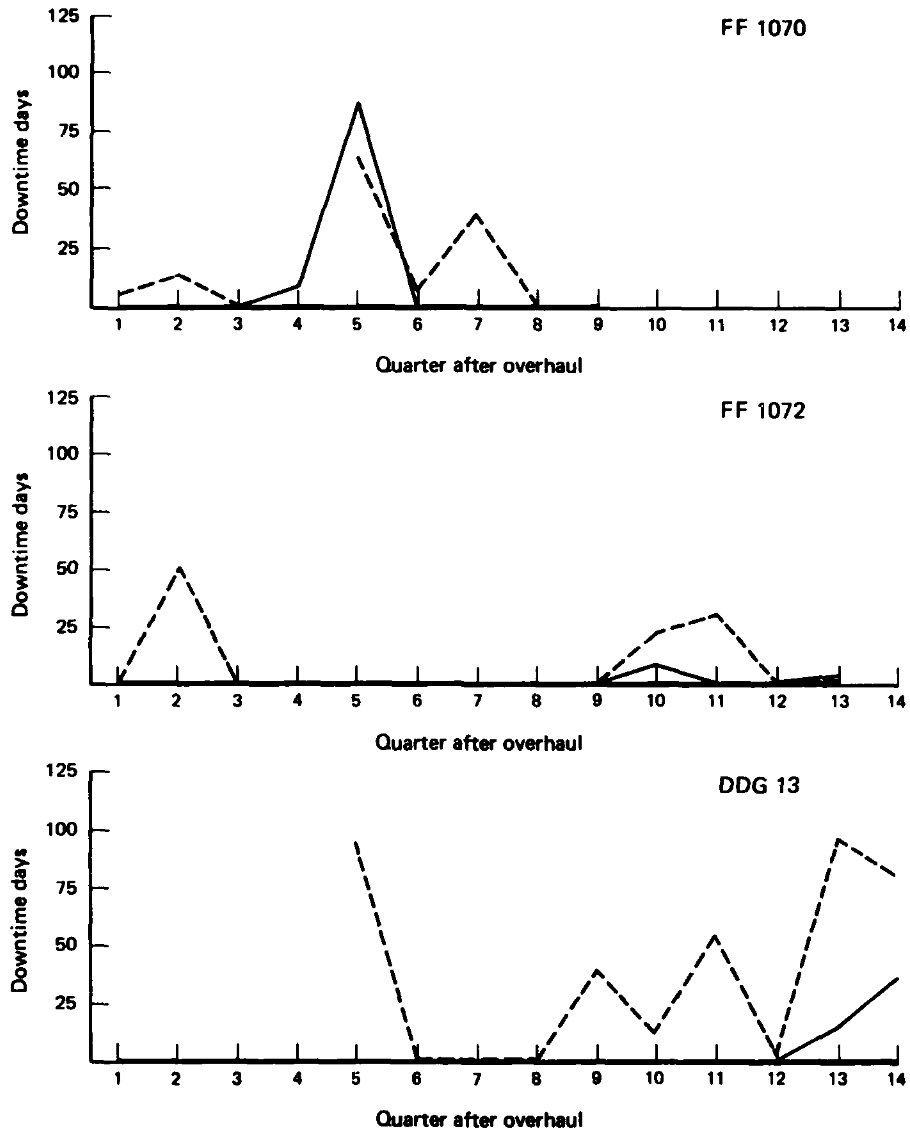


FIGURE 9: (Continued)

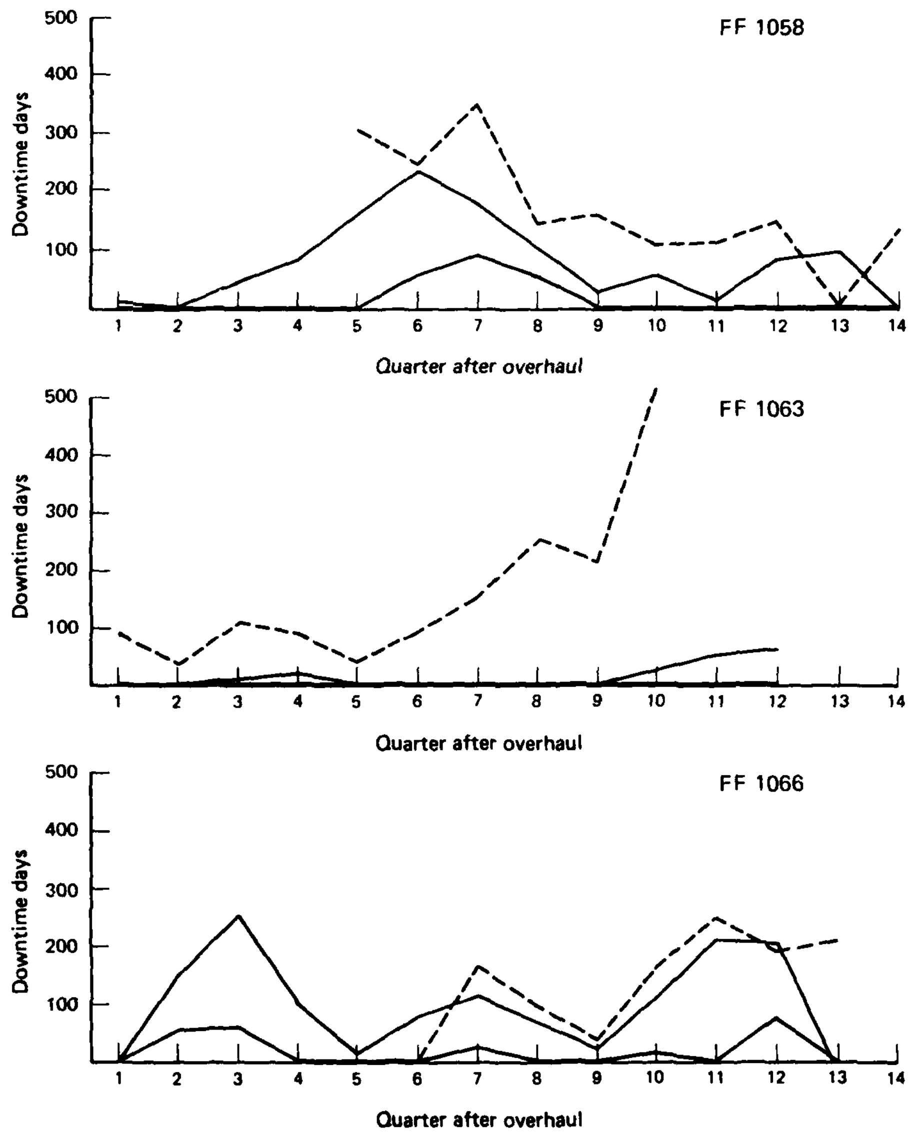


FIG. 10: COMPRESSED AIR DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs

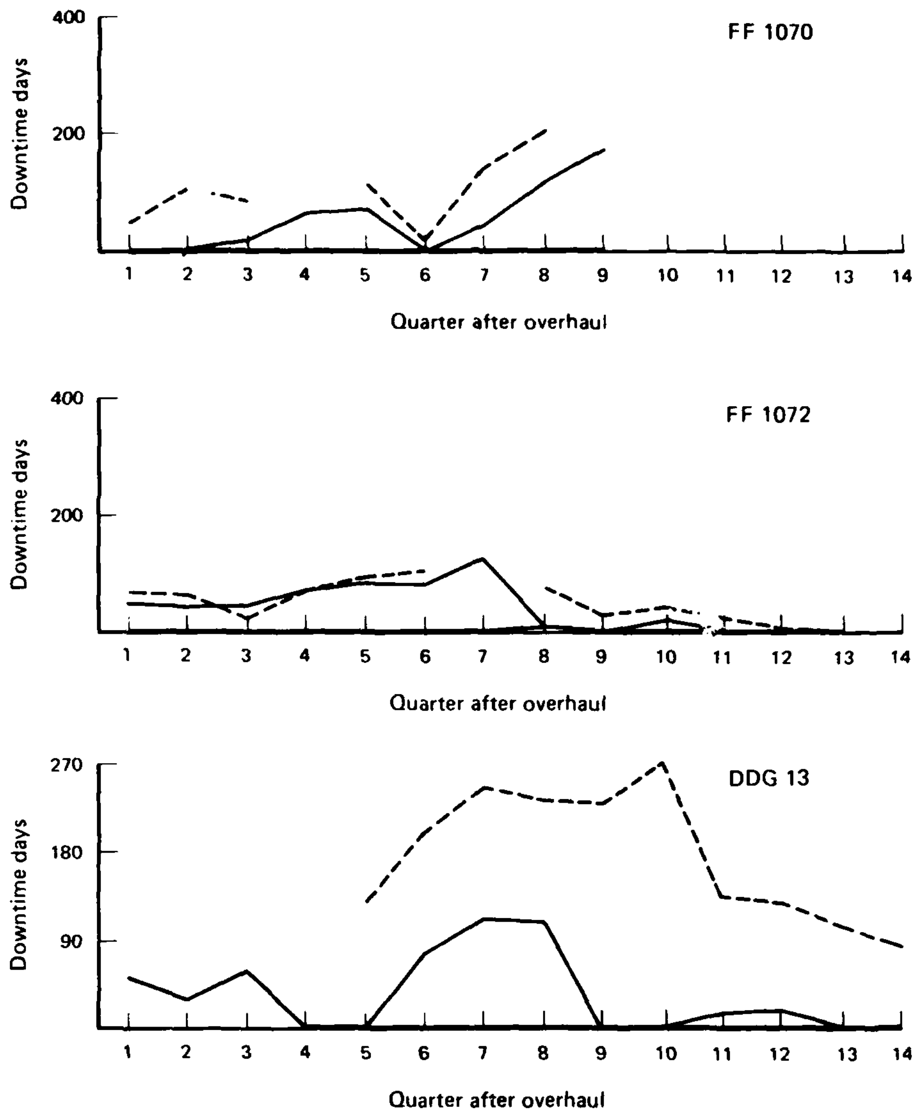


FIGURE 10: (Continued)

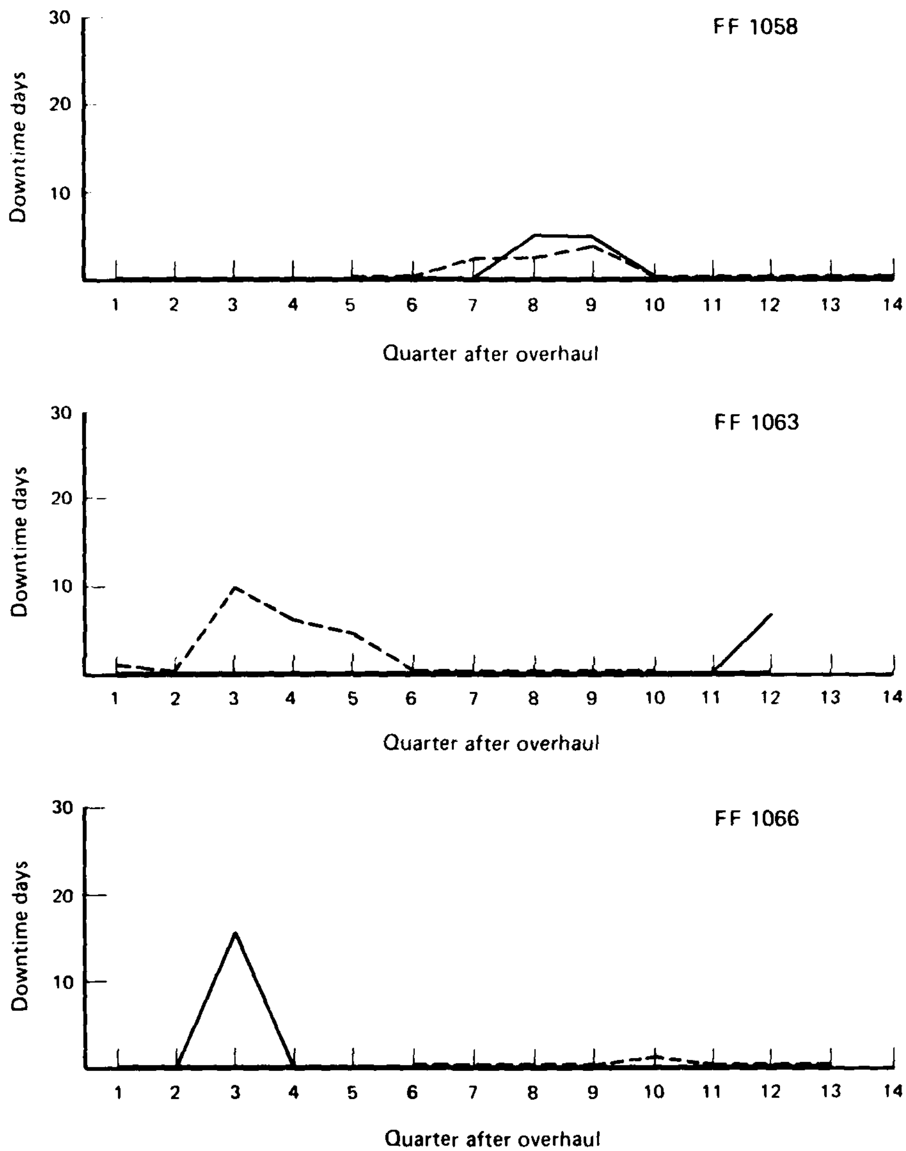
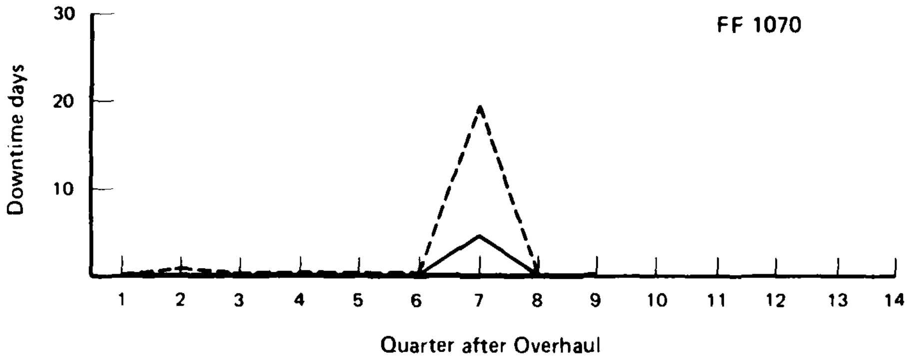
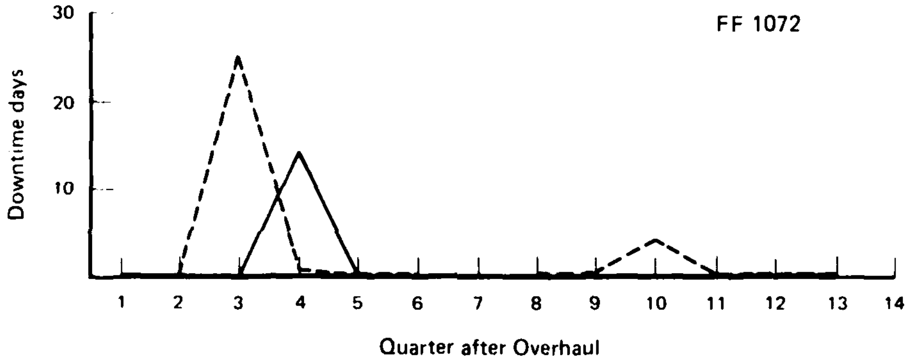


FIG. 11: STEERING DOWNTIMES: ENGINEERING LOGS, C2-C3-C4 CASREPs, C3-C4 CASREPs





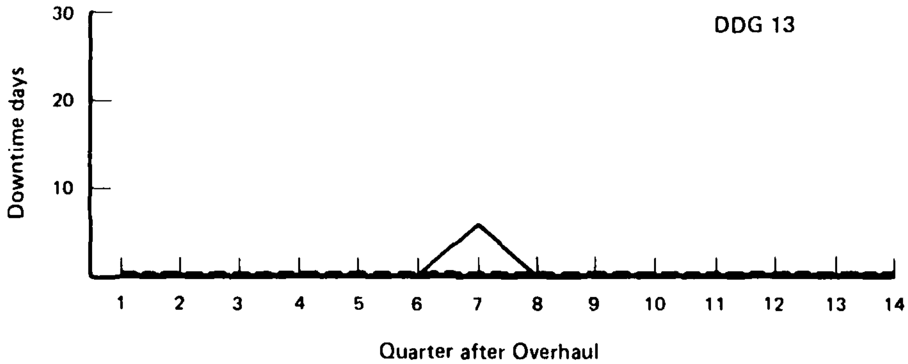


FIGURE 11: (Continued)

a short period of preventative maintenance. By contrast, CASREPs are only filed for serious equipment breakdowns which last a significant amount of time. Moreover, since they may not be filed immediately upon failure, they may somewhat understate the amount of downtime.

Further examination of the figures shows that main propulsion and its subsystems feed and condensate, propulsion boilers, and combustion air show a consistently strong pattern of concurrent peaks and troughs in downtime from the log and CASREP sources. This is also the case for the electrical system and its subsystem power generators.

The remaining systems, which are all auxiliary ones, show a noticeably poorer correlation. Of these, compressed air is the best. Steering and especially refrigeration exhibit a very poor correlation. It is also the case that these systems have a very low level of downtime generally, and of CASREP downtime particularly.

All of these observations are as prevalent for the one DDG as for the FFs. The same behavior is exhibited, and may be expected to hold for DDGs generally. No firmer conclusion, however, may be made based on just the evidence of one ship. One general difference in the DDG from the FFs is the generally lower level of C3-C4 CASREP downtimes relative to all C2-C3-C4 downtimes and to engineering log downtimes.

Figure 12 shows the CASREP downtimes for the whole ship. This serves as a benchmark for the systems. In fact, there is a general trend for all systems of a ship to be high or low in downtime together in any period.

The short horizontal lines in this figure represent the deployment periods of the ships. CASREP downtimes are invariably lower in these periods of deployment, with the large peaks occuring either before or after. Based on the above observation, this holds for system downtimes as well.

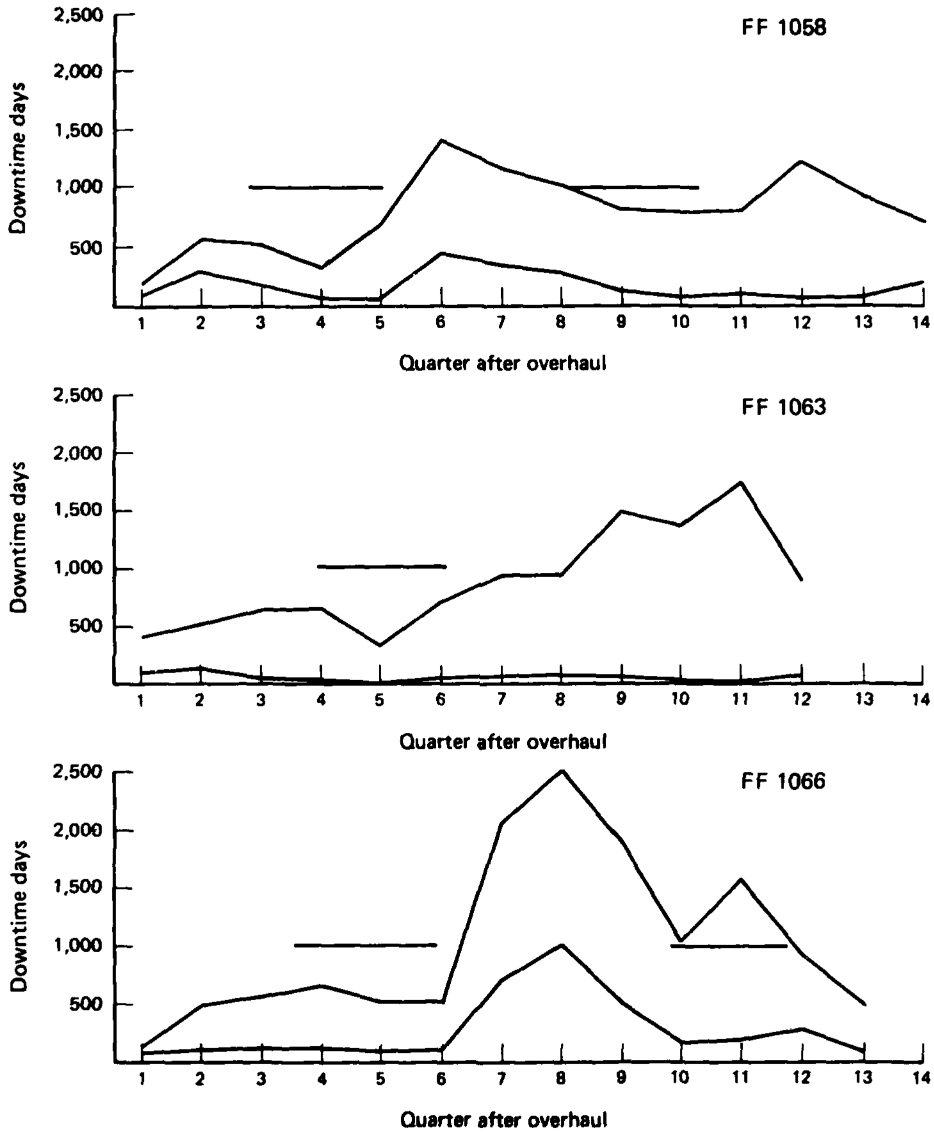


FIG. 12: WHOLE SHIP CASREP C2-C3-C4 AND C3-C4 DOWNTIMES, AND DEPLOYED PERIODS

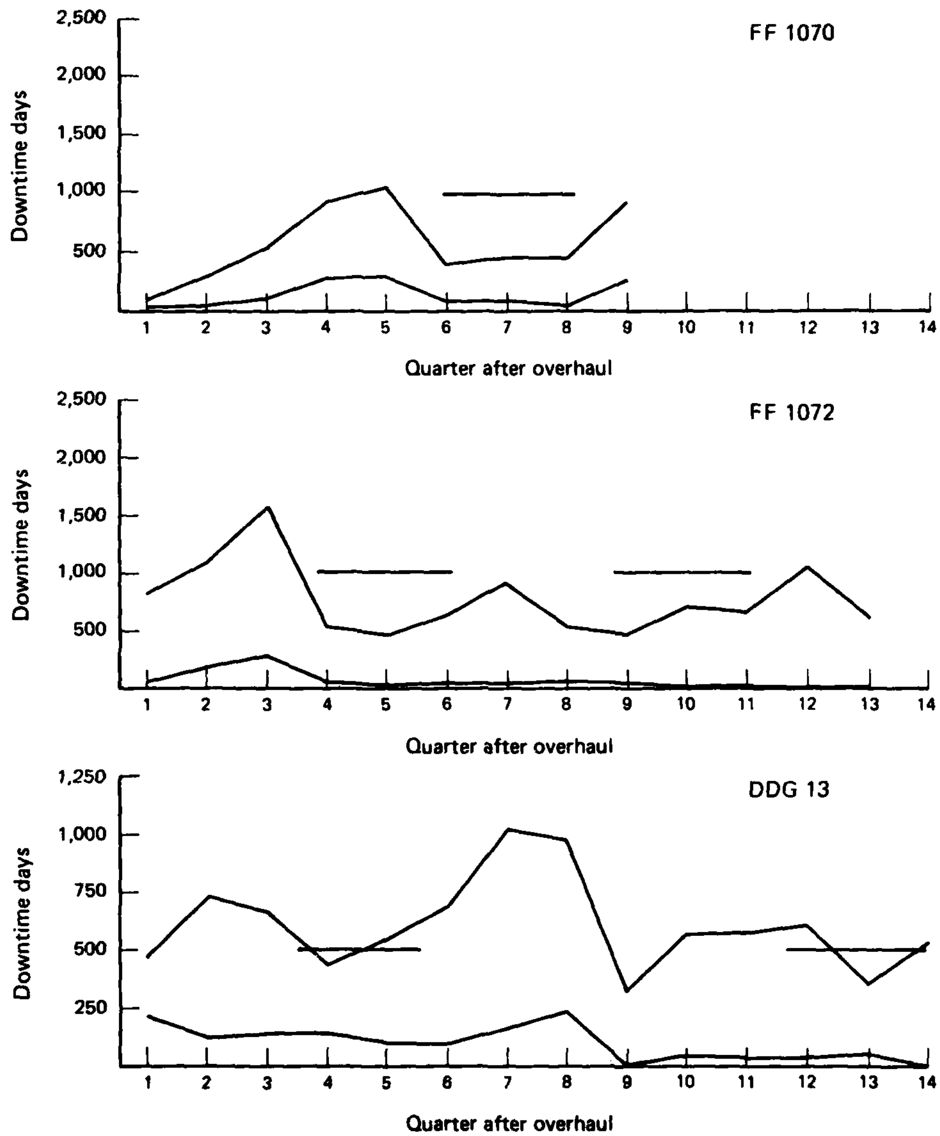


FIGURE 12: (Continued)

DATE
FILMED

-8